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STRUCTURAL EVALUATION OF POROUS PAVEMENT TEST SECTIONS AT WALDEN POND STATE RESERVATION, CONCORD, MASSACHUSETTS

Robert A. Eaton and Peter C. Marzbanian

Prepared for
NORTHEASTERN UNIVERSITY
BOSTON, MASSACHUSETTS
By

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This report presents the results of repeated load tests upon various porous pavement test sections constructed in an overflow parking lot at Walden Pond State Reservation in Concord, Massachusetts. From the fall of 1977 to the spring of 1979, the seasonal structural responses of the sections were monitored with a repeated plate bearing apparatus. After the first set of fall and spring tests, some sections were reconstructed because the asphalt concrete pavement was not porous enough. Test points were added or replaced to accommodate the reconstructed sections. Results show that the dense asphalt concrete distributed the

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load over a greater area than the porous asphalt concrete, thicker pavements were stronger for both dense and porous asphalt concrete, and the deflection basin depth and diameter changed proportionately to applied loads.

PREFACE

This report was prepared by Robert A. Eaton, Research Civil Engineer, and Peter C. Marzbanian, formerly a Student-Trainee (Engineering), Geotechnical Research Branch, Experimental Engineering Division, U.S. Army Cold Regions Research and Engineering Laboratory.

Funding of this study was provided by Northeastern University under contract to the Commonwealth of Massachusetts, Department of Natural Resources, Division of Water Pollution Control.

The authors would like to thank the following for their cooperation, assistance, and comments during the conduct of this study: Charles Faulstich, graduate student, Northeastern University, Boston, Massachusetts; Professor G. Woelfl, Marquette University, Milwaukee, Wisconsin; Professor I. Wei, Northeastern University, Boston, Massachusetts; R. Joubert, Asphalt Institute District Engineer, Wakefield, Massachusetts; and all CRREL engineers and technicians involved with this project.

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STRUCTURAL EVALUATION OF POROUS PAVEMENT TEST SECTIONS AT WALDEN POND STATE RESERVATION, CONCORD, MASSACHUSETTS

Robert A. Eaton
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INTRODUCTION

In the early 1970's, CRREL developed a tractor-trailer-mounted repeated plate bearing (RPB) apparatus as part of its pavement test program. The RPB is capable of conducting repetitive plate bearing tests on roads and airfields with a minimum of set-up and take-down time (Smith et al. 1978). The RPB tests monitor the performance of pavement structures by measuring seasonal strength changes of the various materials within the pavement structure. CRREL uses the RPB apparatus as a research tool in materials characterization and performance evaluations.

In December 1976, the Commonwealth of Massachusetts Water Resources Commission selected Northeastern University of Boston to conduct a research program on porous pavements. Since CRREL was conducting research on a porous pavement and owned the RPB test apparatus, Northeastern University asked CRREL to participate in the project. In March 1977, CRREL signed an agreement to conduct RPB and Benkelman beam tests at Walden Pond State Reservation, Concord, Massachusetts, for Northeastern University under Commonwealth of Massachusetts Contract No. 77-05. This report presents the results of the RPB and Benkelman beam tests made in November 1977, April and September 1978, and March 1979.

TEST SITE

Location

The field study site is a series of connected parking lots used for overflow parking at the Commonwealth of Massachusetts Walden Pond State Reservation on the east side of Route 126 in Concord (see Fig. 1).

Soils

Virgin soils located at the test site are of the Hinckley series, excessively drained soils developed in deep deposits of sands and gravels mainly from granite and gneiss. They commonly have a gravelly loamy sand surface and a sandy and gravelly subsoil underlain by stratified sands and gravel. Hinckley soils are loose throughout and water moves rapidly through them. They are usually stone-free, but may contain a few stones. In a few places, the surface may be stony. Hinckley soils occur on level to very steep slopes.

Weather

The design freezing index for Walden Pond is 750°F-days based on the coldest year in thirty years and the mean freezing index is 250°F-days

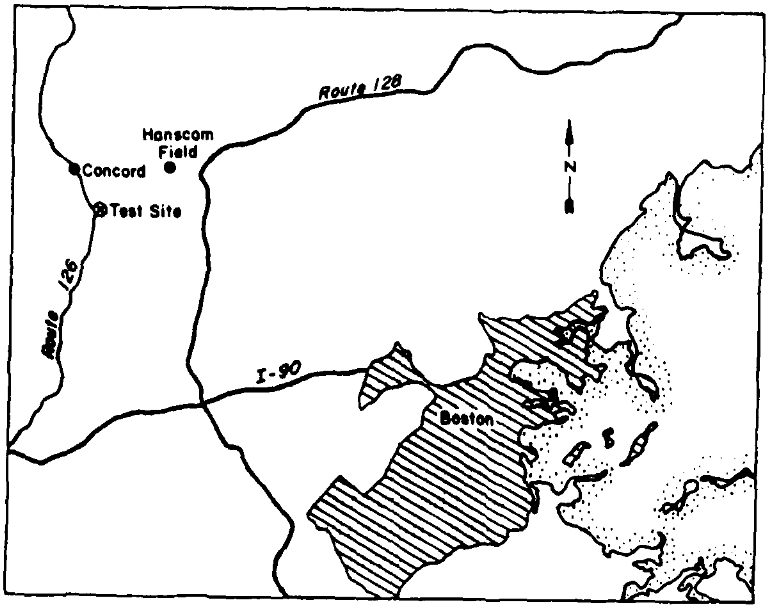

Figure 1. Test site location.

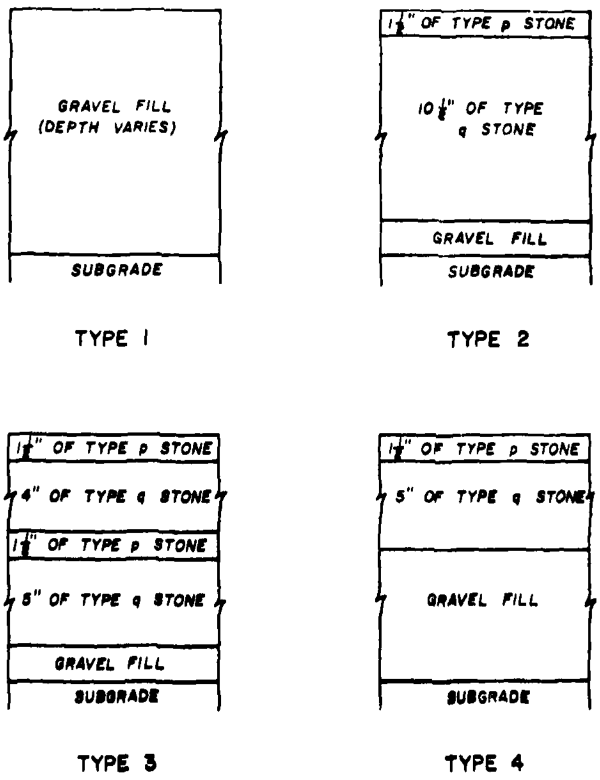

Figure 2. Base course types.

(Dept. of the Army 1965). From a 24-yr record, the mean annual temperature and average total precipitation at Hanscom Field, Bedford, Massachusetts (Fig. 1), are 48.5°F and 43.7 in., respectively (Air Weather Service).

TEST PAVEMENT CHARACTERISTICS

The 8 areas of the overflow parking lots were divided into 13 cross sections of pavements by Northeastern University (Table 1). Mix classes, gradations, and base course types are defined in Table 2 and Figure 2. Figures 3 and 4 show the locations of the various test sections. In the summer of 1978, the pavements on some of the sections were removed and replaced because of improper mix gradations. Most of the test points were repainted in the same location as the ones that had been removed and a few new points were added. The original points are shown in Figure 5 and the reconstructed sections are shown in Figure 6. Figure 7 shows all test points after reconstruction.

RPB and Benkelman beam tests were run on each point. The cross-section options chosen by Northeastern University to be investigated (Table 3) included:

1. Control sections 1, 2 and 3 made up of

   a) the standard Commonwealth of Massachusetts dense graded asphalt concrete,
   b) an open graded (porous) asphalt concrete (A.C.), and
   c) a gravel section,

all on the existing gravel base.

2. Sections 4, 5, and 6 have a 2- to 3-in.-thick open graded or porous pavement on

   a) a 12-in. base,
   b) a 6 1/2-in. base, and
   c) a 12-in. "sandwiched" base.

These sections were built to assess the influence of open-graded base course thickness on drainage and structural strength.

INSTRUMENTATION

A small weather station was installed at the site to monitor ambient air temperature and precipitation. Thermistors were installed at various depths in the base and subgrade layers of the test sections to monitor frost depths (see Fig. 8). Collection wells were installed to obtain samples of water running over and through various components of the cross sections for analysis.

Table 1. Walden pond pavement cross sections.

Test section	1A	1B	2A	2B	2C	2D	3A	3B	4A	4B	4C	4D	5A	5B	5C	5D	6A	6B	6C	6D	7A	7B
Dense graded asphalt concrete	2.5"	2.5"					0"	0"														
Open graded asphalt concrete			2.5"	2.5"	2.4"	2.4"	0"	0"	2.5"	2.5"	2.4"	2.4"	2"	2.25"	2.1"	2.1"	2.5"	3"	2.1"	2.1"	1.5"	1.5"
Open graded base																						
1/2" stone									1.5"	1.5"	1.5"	1.5"	1.5"	1.5"	1.5"	1.5"	1.5"	1.5"	1.5"	1.5"		
1 1/2" - 2" stone									10.5"	10.5"	10.5"	10.5"	5"	5"	5"	5"	4"	4"	4"	4"		
1/2" stone																	1.5	1.5	1.5	1.5		
1 1/2" stone																	5	5	5	5		
Existing gravel base	12"	36"	36"	36"	36"	36"	0"	6"	24"	24"	24"	24"	30"	30"	30"	30"	24"	24"	24"	24"	36"	36"

7C	7D	8A	8B	8C	8D	9A	9B	9C	9D	10A	10B	10C	10D	11A	11B	12A	12B	13A	13B
														4"	4"				
1.6"	1.6"	3.75"	4"	4.4"	4.4"	1.25"	1.5"	1.2"	1.2"	4"	4"	2.9"	2.9"			2.5"	2.5"	2.75"	2.5"
						1.5"	1.5"	1.5"	1.5"	1.5"	1.5"	1.5"	1.5"						
						5"	5"	5"	5"	5"	5"	5"	5"						
36"	36"	36"	36"	36"	36"	30"	30"	30"	30"	24"	30"	24"	30"	36"	36"	36"	36"	36"	36"

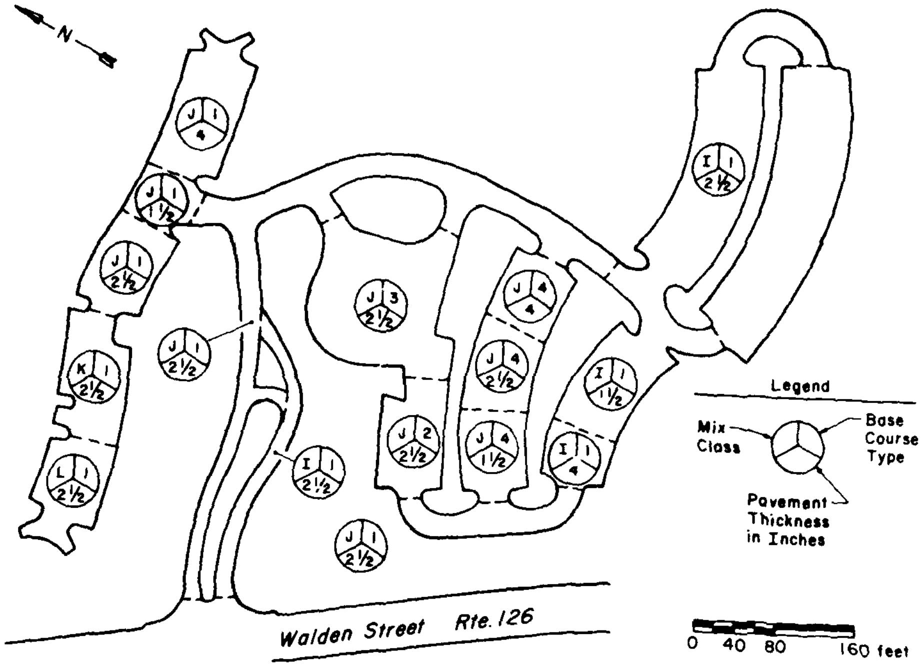

Figure 3. Mix class and base course type locations.

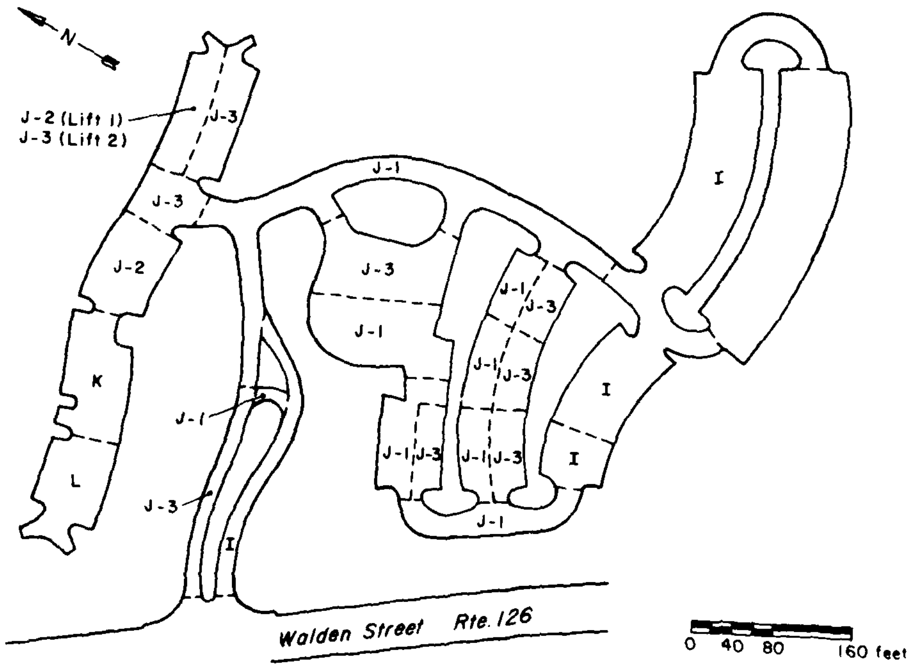

Figure 4. As-built mix locations.

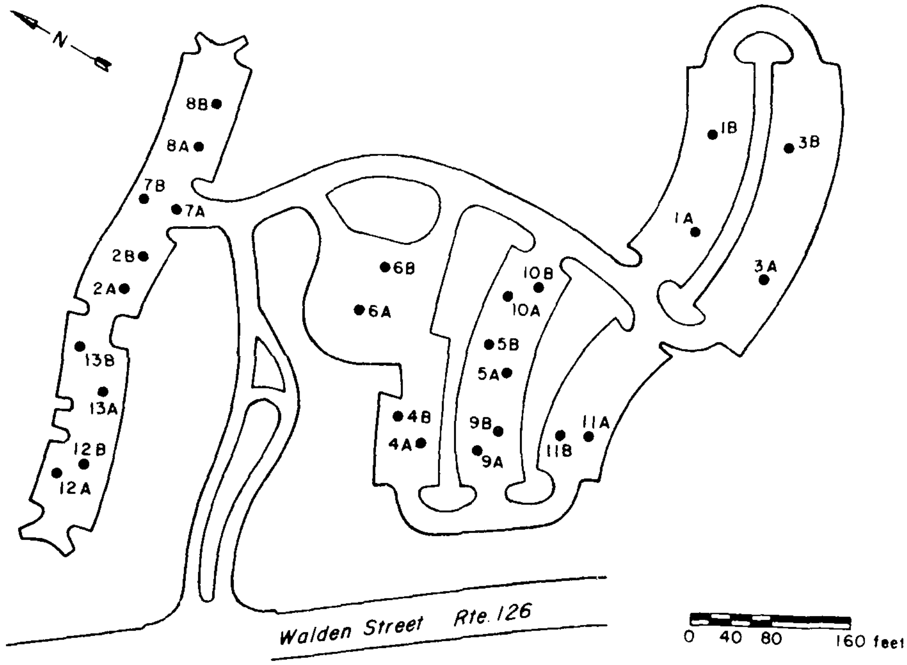

Figure 5. Original test points.

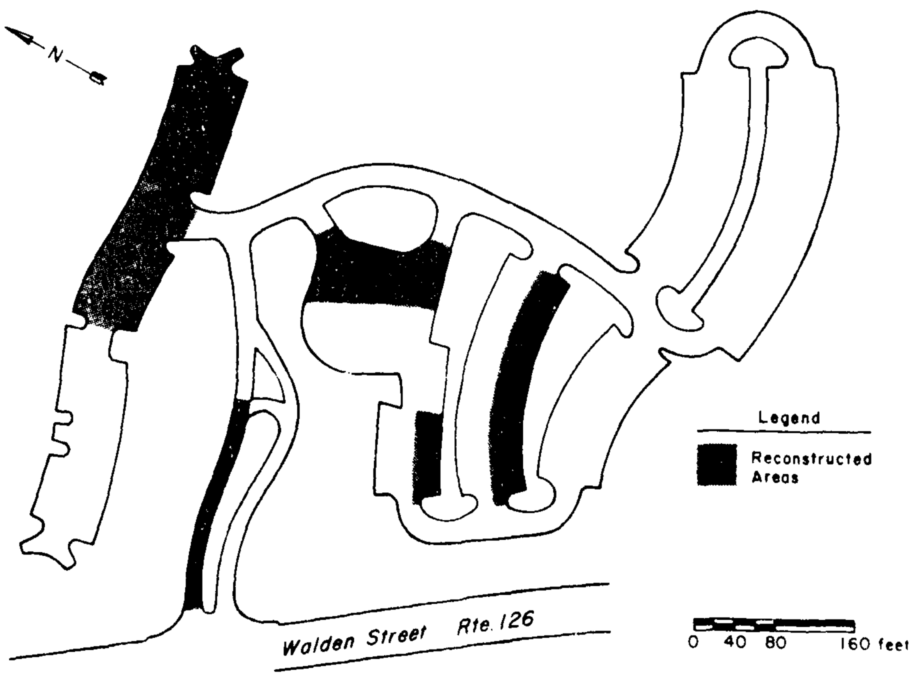

Figure 6. Reconstructed areas.

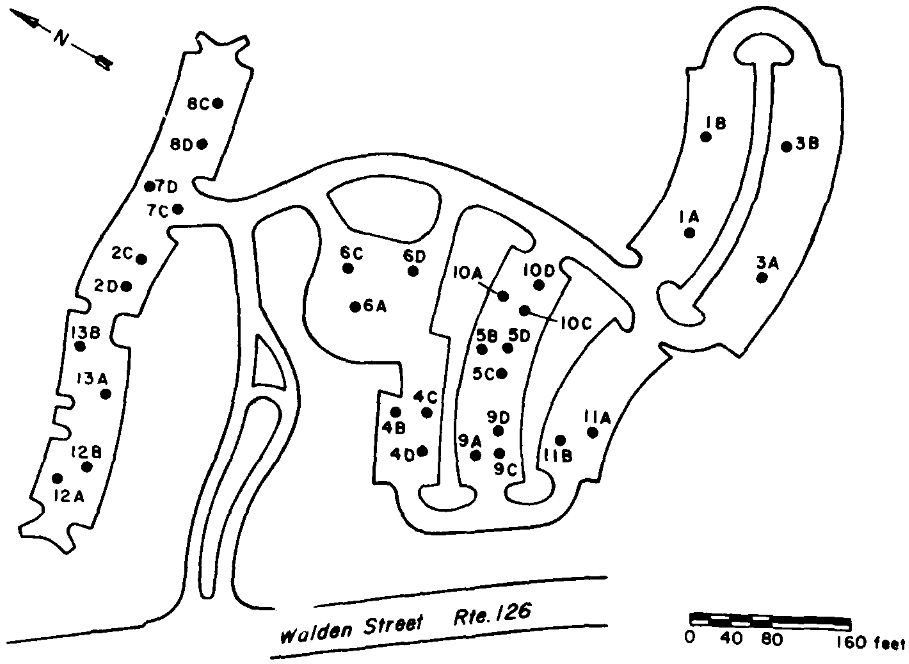

Figure 7. Test points after reconstruction.

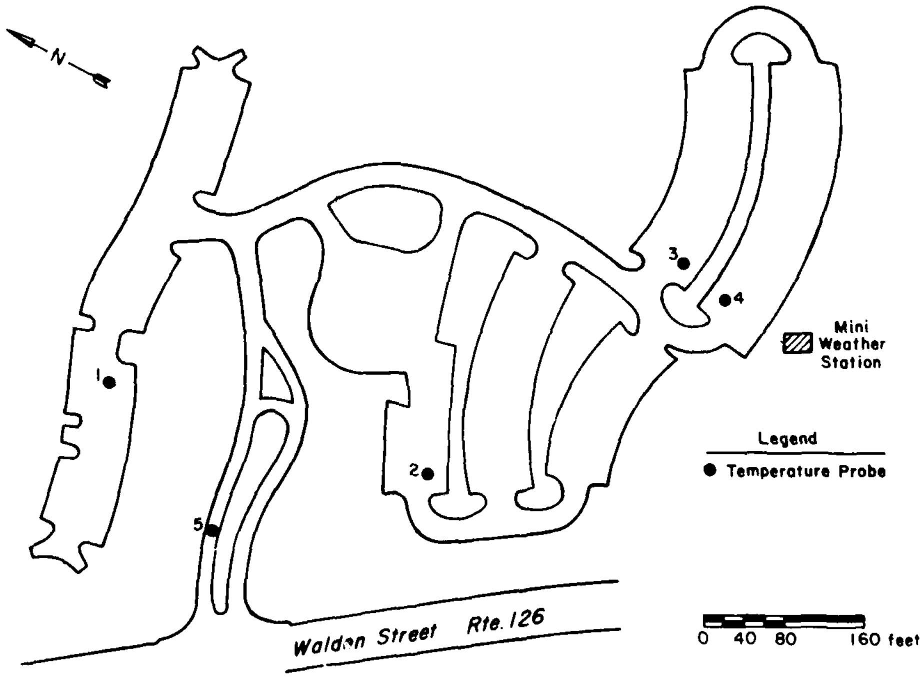

Figure 8. Temperature probe locations.

Table 2. Pavement mix gradations and asphalt contents.

Sieve	I Binder	I Top	J-1	J-2	J-3	K	L
7/8-in.	100						
3/4-in.	93						
1/2-in.	68	100	99-100	100	100	100	100
3/8-in.		93	92-96	90	92	96-99	90-92
4	37	63	46-58	47	38	43-47	50-52
8			24-29	19	19	10-14	32
10	26	40					
16			18-23	14	10	5-9	24-25
20		31					
40	13	20					
80		12					
200	2	4	1-2.3	0.7	0.4	1-2.3	2-2.6
Asphalt content (% by wt of mix)	5	6.4	4.7-5.9	4.7	4.8	4.2-4.9	4.6-4.9

REPEATED PLATE BEARING (RPB) TEST APPARATUS

The CRREL repetitive plate bearing test vehicle (Fig. 9) is a self-contained, trailer-mounted pavement testing apparatus, capable of conducting repetitive plate bearing tests on roads and airfields with a minimum of set-up and take-down time. The trailer has a gross weight of 36,000 lb and is 27 ft long, 12 ft high, and 8 ft wide. The axle load of the trailer has been designed to be 18,000 lbs so that the vehicle can be used to conduct standard Benkelman beam static rebound tests.

Power is supplied by a 7.5-kW, 120/240-V electric generator driven by an air-cooled gasoline engine installed inside the trailer. Hydraulic rams located at each corner of the trailer are used to lift the trailer wheels off the test surface. Each ram has an 18-in.-square aluminum foot plate that is connected to the ram via a removable pin.

The plate bearing load actuator is a two-chamber pneumatic-hydraulic pressure transformer. To generate the plate bearing load pulse, an air pressure pulse of approximately 80 psi is supplied to the upper chamber. The lower chamber, which is filled with ethylene glycol, converts this pressure pulse into a 9000-lbf pulse. A load cell installed between the lower chamber and the load plate provides a continuous readout of the force transmitted.

A 14.4-ft^3/min two-stage air compressor driven by an electric motor supplies compressed air for the load actuator. A two-way air control valve actuated by a solenoid generates the compressed air pressure pulse. A

Table 3. Test section variables.

Test section	Design	Variable
1	dense 2 1/2-in. A.C.* on existing gravel	
2	open-graded 2 1/2-in. A.C. on existing gravel	Control
3	existing gravel	sections
4	2 1/2-in. open A.C. on 12-in. open graded base	Open-graded
5	2 1/2-in. open A.C. on 6 1/2-in. open graded base	bases
6	2 1/2-in. open A.C. on 12-in. open graded base	
7	1 1/2-in. open A.C. on existing gravel	Thickness of
8	4-in. open A.C. on existing gravel	porous
9	1 1/2-in. open A.C. on 6 1/2-in. open graded base	pavement
10	4-in. open A.C. on 6 1/2-in. open graded base	
11	4-in. dense A.C.	
12	Class L mix	Less porous
13	Class K mix	More porous

Notes: * A.C. is asphalt concrete

Sections 1 and 11 are the standard Commonwealth of Massachusetts dense graded mix.

Sections 2 and 4 through 10 are the California gradation porous asphalt mix.

Section 12 was less porous than the California mix.

Section 13 was more porous than the California mix.

Sections 12 and 13 were suggested by the construction contractor (Warren Brothers).

Sections 2 and 4 through 10 were reconstructed because they were too dense. The replaced thicknesses were the same as the originals.

The actual asphalt concrete thicknesses are shown in Table 1.

solid state timer regulates the air control valve. The timer circuit is adjustable to allow variation in the duration of the pressure pulse and the elapsed time between pulses. The duration is continuously adjustable between 0.2 and 20 seconds. The pulse frequency is also continuously adjustable from 30 repetitions per minute to 1 repetition every 3 minutes. The number of pulses during the test is automatically recorded.

Flow restrictors with adjustable needle valves in the supply and exhaust lines of the load actuator allow the rate of pressure rise and pressure release to be adjusted. This adjustment enables the operators to use a standardized load pulse at test sites with different response stiffnesses.

Linear variable differential transformers (LVDTs) are used to monitor the motion of the 12-in.-diameter load plate and the surface deflection basin. The dc-type LVDTs are mounted on an 18-ft reference beam, with two positioned on the load plate on perpendicular radii and four in the surface deflection basin aligned with one of the plate LVDTs (Fig. 10). A strip-chart recorder monitors the LVDT and load cell outputs (Smith et al. 1978).

RPB TEST SEQUENCE

The test section construction was completed in October 1977. The fall (or "normal period") baseline RPB tests were conducted on 14 and 15 November 1977. Two points (A and B) were selected per test section (a total of 26 points) for verification of results. Tests were conducted by setting up over each test point, applying 50 repetitions of loads at approximately 6,500 lb (60 psi), increasing the load to approximately 9,000

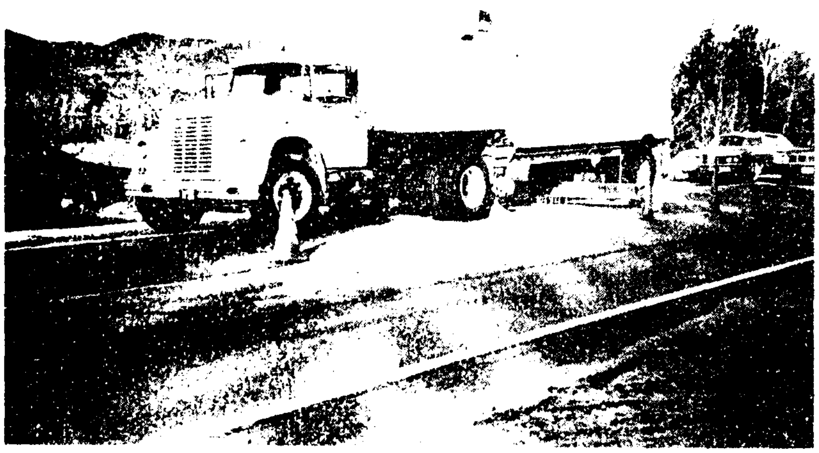

Figure 9. Repetitive plate bearing apparatus.

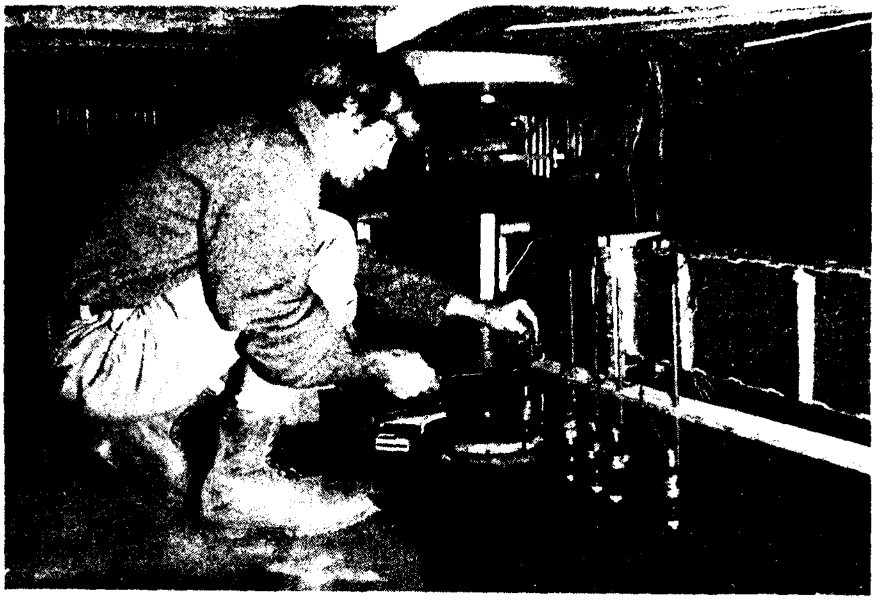

Figure 10. LVDT set up for deformation measurements.

lb (80 psi) for 50 repetitions, followed by 50 repetitions at approximately 11,300 lb (100 psi). Total time from set-up to take-down was about 20 to 25 minutes.

Tests were again run on 18 and 19 April 1978 at 17 of the 26 points. Fifty load repetitions at 60, 80 and 100 psi were applied to test points 1B, 2B, 12B and 13B. Fifty load repetitions at 80 and 100 psi were applied to test points 1A, 2A, 3B, 4A, 5A, 6B, 7B, 8B, 9B, 10A, 11B, 12A, and 13A. The test sequence was shortened in the spring per prior contractual agreement with Northeastern University.

In the fall of 1978 after reconstruction of some of the sections, tests were run on 26 of the 31 points. Fifty load repetitions at 60, 80, and 100 psi were applied to test points 1A, 1B, 2C, 2D, 4C, 4D, 5C, 5D, 6C, 6D, 7C, 7D, 8C, 8D, 9C, 9D, 10C, and 10D. Fifty load repetitions at 80 and 100 psi were applied to test points 3A, 3B, 11A, 11B, 12A, 12B, 13A and 13B.

Tests were conducted again on 14 and 15 March 1979. All 31 points were tested with 50 load repetitions at 60, 80, and 100 psi.

All resilient deflection measurements from the four testing periods are tabulated in Appendix A along with a table listing the points in order of strength. The measurement of the dynamic deflection basin is shown in Figure 11.

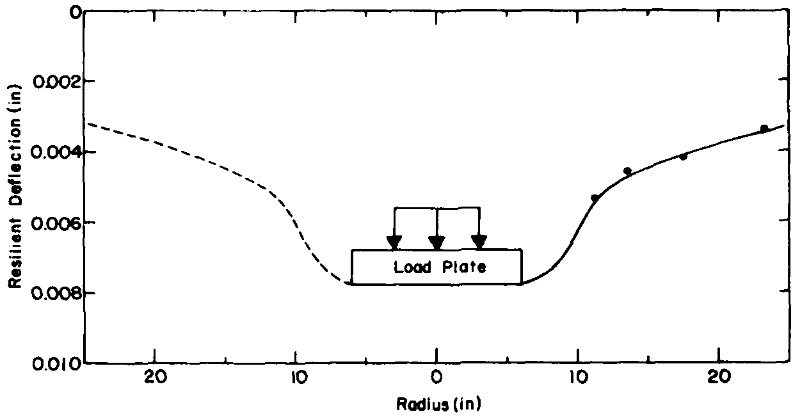

Figure 11. Measurement of typical deflection basin.

RPB TEST RESULTS

Porous vs. dense pavements

The 4.4 in. of porous pavement deflected more at the plate than the 4 in. of dense pavement under the 80- and 100-psi loads (see Fig. 12 and 13). Thirty inches from the point of loading, the dense pavement deflected more than twice as much as the porous pavement, indicating that the dense pavement can distribute a load over a greater area than the porous pavement. This ability means the dense pavement is less likely to shear or punch.

Various thicknesses of dense pavement

Figures 14 and 15 show that the 4-in. dense asphalt concrete in section 11 had a lower plate deflection than the 2 1/2-in. dense asphalt concrete in section 1, both in November 1977 and in September 1978. However, 30-in. from the point of loading, the 4-in. dense layer deflected almost twice as much as the 2 1/2-in. layer.

Various thicknesses of porous pavement

Figure 16 shows that the 2.9-in. porous asphalt concrete in section 10 deflected less at the plate than the 2.1-in. or 1.2-in. porous asphalt concrete in sections 5 and 9 respectively. All three sections had nearly the same deflection at 30 in. from the load plate.

Loading on unpaved gravel

Figure 17 shows that test point 3B, which had 6-in. of gravel base over the in situ subgrade, deflected less than 3A, which had no gravel, demonstrating the greater strength of a gravel base over a subgrade.

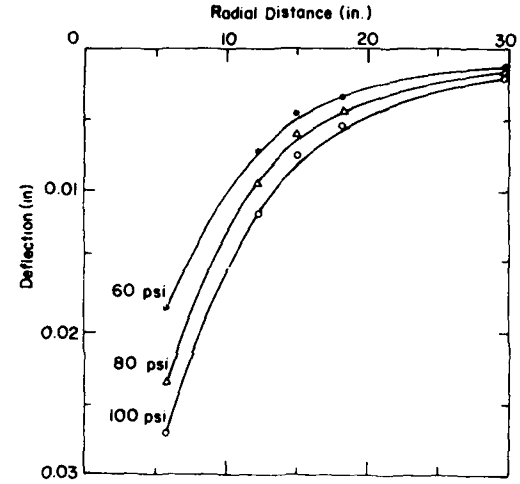

Figure 12. Various loads on 4.4-in.-thick porous pavement section 8D on 27 September 1978.

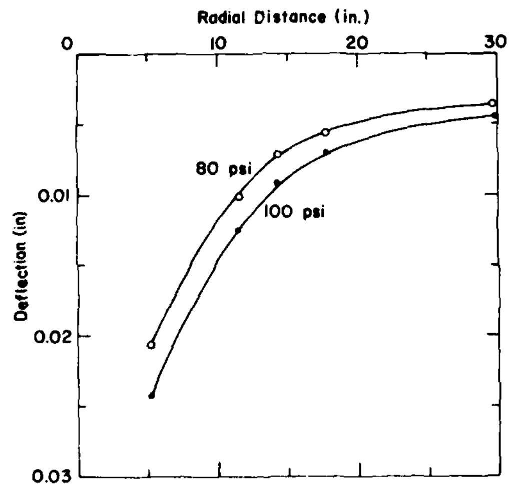

Figure 13. Various loads on 4-in.-thick pavement section 11B on 27 September 1978.

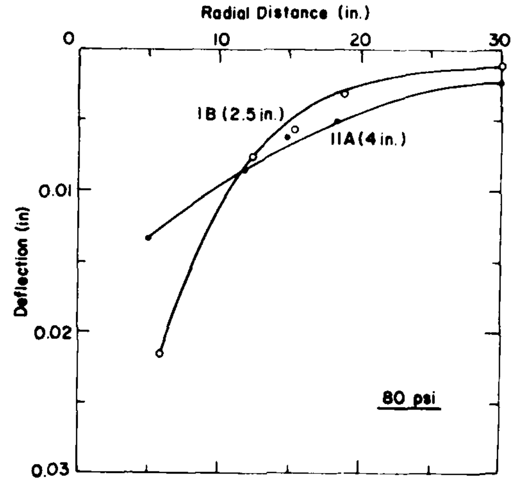

Figure 14. Various thicknesses of dense pavement (14 Nov 1977).

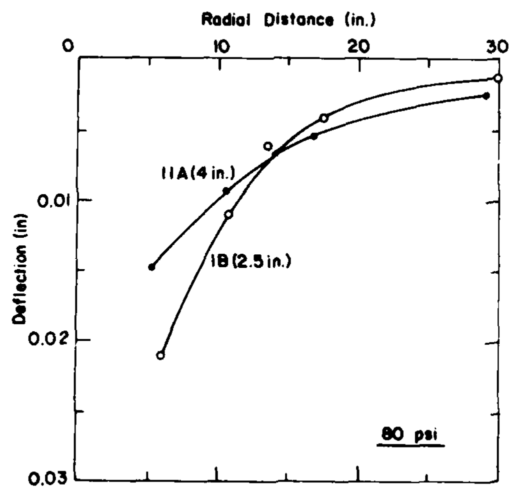

Figure 15. Various thicknesses of dense pavements (27 Sept 1978).

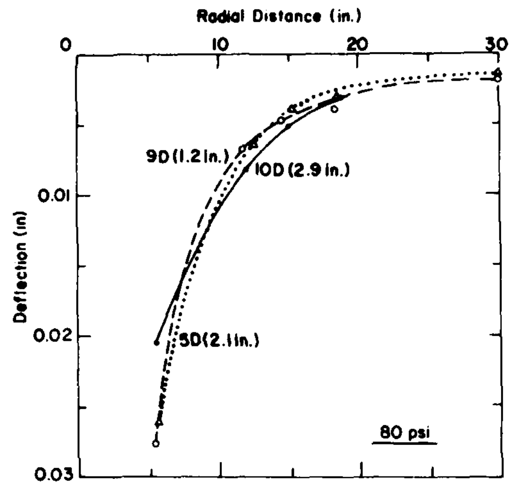

Figure 16. Various thicknesses of porous pavement (27 Sept 1978).

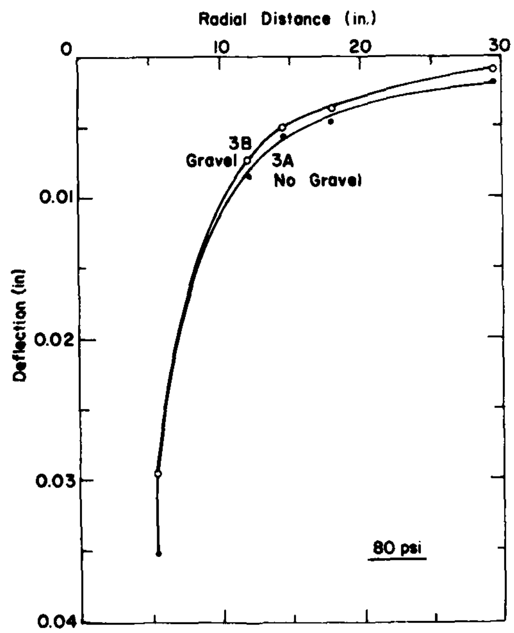

Figure 17. Gravel vs base (27 Sept 1978).

Effects of loading on subgrade

As the load was increased on point 3A (in situ soil) the deflection basin increased proportionately as expected (see Fig. 18).

BENKELMAN BEAM TEST DESCRIPTION

The Benkelman beam test is a standard static rebound test (ASTM 1970). Using a rear axle load of 18,000 lb, measurements are made as the load is slowly moved away from the test point (see Fig. 19). The results of this test are an indication of the combined strength of the pavement, subbase, and subgrade. Benkelman beam tests were run with the CRREL test vehicle on 14 November 1977, 19 April 1978, 28 September 1978, and 14 March 1979 in conjunction with the RPB tests. Tables 4 and 5 present the test results. From these data, the following analysis can be made.

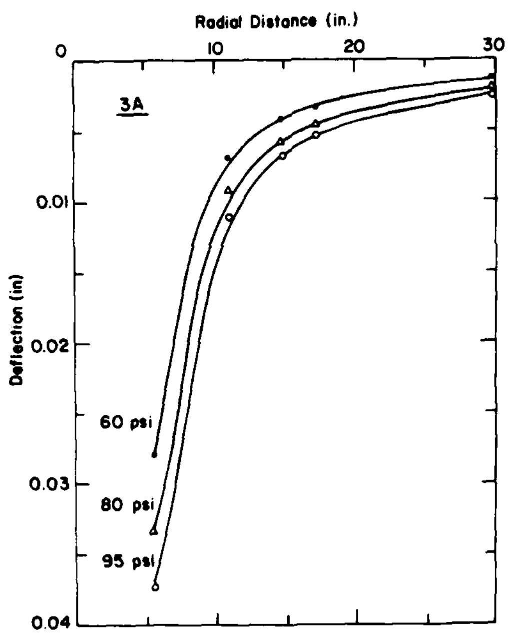

Figure 18. Various loads on subgrade--1978.

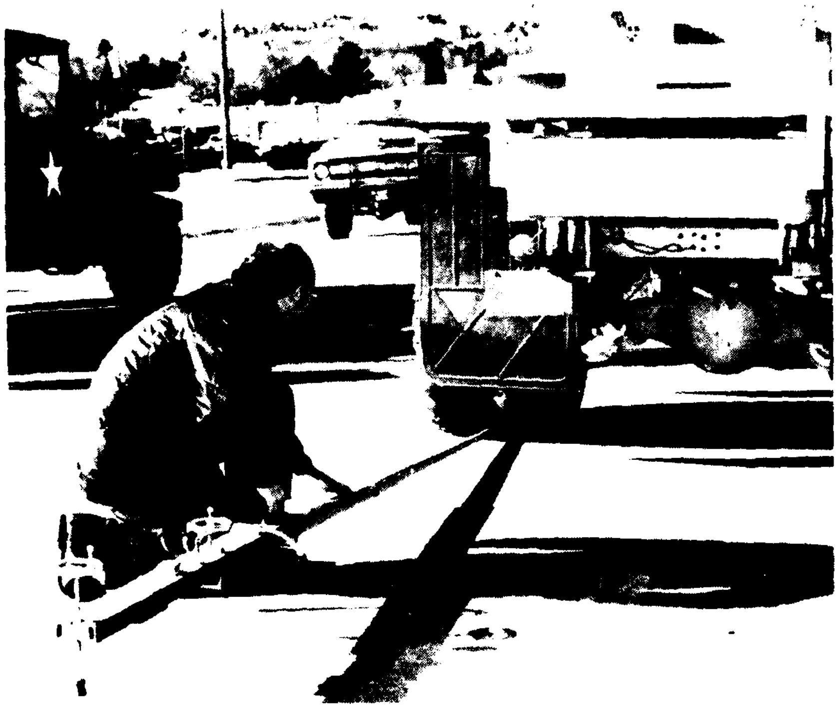

Figure 19. Benkelman beam test.

Table 4. Walden Pond Benkelman beam tests.

	14 Nov '77	19 Apr '78	28 Sep '78	15 Mar '80
1A	0.0155	0.0290	0.0209	0.0277
1B	0.0315	0.0325	0.0087	0.0250
2A	0.0245	0.0320	-	-
2B	0.0235	0.0285	-	-
2C	-	-	0.0244	0.0250
2D	-	-	0.0260	0.0315
3A	0.0270	0.0280	0.0204	0.0435
3B	0.0285	0.0275	0.0184	0.0530
4A	0.0360	0.0475	-	-
4B	0.0330	0.0400	0.0205	0.0246
4C	-	-	0.0403	0.0251
4D	-	-	0.0322	0.0250
5A	0.0295	0.0365	-	-
5B	0.0290	0.0410	0.0260	0.0290
5C	-	-	0.0419	0.0340
5D	-	-	0.0293	0.0284
6A	0.0245	0.0345	0.0280	0.0344
6B	0.295	0.0400	-	-
6C	-	-	0.0340	0.0314
6D	-	-	0.0380	0.0279
7A	0.0295	0.0365	-	-
7B	0.0290	0.0290	-	-
7C	-	-	0.0231	0.0391
7D			0.0091	0.0430
8A	0.0180	0.0280	-	-
8B	0.0170	0.0265	-	-
8C	-	-	0.0204	0.0314
8D	-	-	0.0125	0.0197
9A	0.0335	0.0445	0.0400	0.0724
9B	0.0220	0.0445	-	-
9C	-	-	0.0342	0.0408
9D	-	-	0.0287	0.0440
10A	0.0225	0.0350	0.0164	0.0206
10B	0.0225	0.0310	-	-
10C	-	-	0.0283	0.0268
10D	-	-	0.0217	0.0264
11A	0.0155	0.0195	0.0134	0.0120
11B	0.0245	0.0205	0.0090	0.0195
12A	0.0260	0.0355	0.0130	0.0237
12B	0.0195	0.0275	0.0194	0.0236
13A	0.0200	0.0315	0.0157	0.0276
13B	0.0240	0.0325	0.0285	0.0352

Table 5. Walden Pond Benkelman beam results in order of strength

14 Nov '77	19 Apr '78	28 Sep '78	15 Mar '78
1A - 0.0155	11A - 0.0195	1B - 0.0087	11A - 0.0120
11A - 0.0155	11B - 0.0205	11B - 0.0090	11B - 0.0195
8B - 0.0170	8B - 0.0265	7D - 0.0091	8D - 0.0197
8A - 0.0180	12B - 0.0275	8D - 0.0125	10A - 0.0206
12B - 0.0195	3B - 0.0275	12A - 0.0130	12B - 0.0236
13A - 0.0200	8A - 0.0280	11A - 0.0134	12A - 0.0237
9B - 0.0220	3A - 0.0280	13A - 0.0157	4B - 0.0246
10A - 0.0225	2B - 0.0285	10A - 0.0164	1B - 0.0250
10B - 0.0225	1A - 0.0290	3B - 0.0184	2C - 0.0250
2B - 0.0235	7B - 0.0290	12B - 0.0194	4D - 0.0250
13B - 0.0240	10B - 0.0310	3A - 0.0204	4C - 0.0251
2A - 0.0245	13A - 0.0315	8C - 0.0204	10D - 0.0264
6A - 0.0245	2A - 0.0320	4B - 0.0205	10C - 0.0268
11B - 0.0245	1B - 0.0325	1A - 0.0209	13A - 0.0276
12A - 0.0260	13B - 0.0325	10D - 0.0217	1A - 0.0277
3A - 0.0270	6A - 0.0345	7C - 0.0231	6D - 0.0279
3B - 0.0285	10A - 0.0350	2C - 0.0244	5D - 0.0284
5B - 0.0290	12A - 0.0355	2D - 0.0260	5B - 0.0290
7B - 0.0290	5A - 0.0365	5B - 0.0260	6C - 0.0314
5A - 0.0295	7A - 0.0365	6A - 0.0280	8C - 0.0314
6B - 0.0295	4B - 0.0400	10C - 0.0283	2D - 0.0315
7A - 0.0295	6B - 0.0400	13B - 0.0285	5C - 0.0340
1B - 0.0315	5B - 0.0410	9D - 0.0287	6A - 0.0344
4B - 0.0330	9A - 0.0445	5D - 0.0293	13B - 0.0352
9A - 0.0335	9B - 0.0445	4D - 0.0322	7C - 0.0391
4A - 0.0360	4A - 0.0475	6C - 0.0340	9C - 0.0408
		9C - 0.0342	7D - 0.0430
		6D - 0.0380	3A - 0.0435
		9A - 0.0400	9D - 0.0440
		4C - 0.0403	3B - 0.0530
		5C - 0.0419	9A - 0.0724

BENKELMAN BEAM TEST RESULTS

Porous vs. dense pavements

The 4-in. dense pavement deflected less than the 4.4-in. porous pavement (Table 6). Both sections had identical base courses.

Effect of porous pavement thickness

On a gravel base, the 4.4-in. porous A.C. deflected less than the 2.4-in. porous A.C. and the 2.4-in. porous A.C. deflected less than the 1.6-in. porous A.C. On a crushed rock base, the 2.9-in. porous A.C. deflected less than the 2.1-in. and 1.2-in. porous A.C. The 2.1-in. section deflected less than the 1.2-in. section.

Effect of dense pavement thickness

In sections with the same base courses, the 4-in. dense A.C. deflected less than the 2.5-in. dense A.C.

CONCLUSIONS

Repetitive plate bearing and Benkelman beam tests showed that:

- Four inches of open graded asphalt concrete deflected the same amount as 4-in. of dense graded asphalt concrete under the 60- and 80-psi loadings. However, the 4-in. open graded pavement deflected 0.0018 in. more than the 4-in. dense pavement at the plate under the 100-psi load.

- Dense asphalt concrete distributed the load over a greater area than the porous asphalt concrete.

- Four inches of dense graded asphalt concrete was stronger than 2 1/2-in. of the same pavement.

- Four inches of porous graded asphalt concrete was stronger than 2 1/2-in. of the same pavement.

- Gravel was stronger than the in situ soil.

- The deflection basin depth and diameter increased proportionately with increased load.

- A comparison of the deflections of the base course and pavement test sections with the deflections of a gravel test section underscored the benefits of the base course and the pavement.

Table 6. Benkelman beam deflection comparisons.

Point	Thickness and type of pavement	Date	Deflection (in.)
Porous vs. dense			
11A	4-in. dense A.C.	3/15/79	0.0120
8C	4.4-in. porous A.C.	3/15/79	0.0314
11A	4-in. dense A.C.	9/27/78	0.0134
8C	4.4-in. porous A.C.	9/27/78	0.0204
Dense vs. dense			
11A	4-in. dense A.C.	3/15/79	0.0120
1B	2.5-in. dense A.C.	3/15/79	0.0250
11A	4-in. dense A.C.	11/14/77	0.0155
1B	2.5-in. dense A.C.	11/14/77	0.0315
Porous vs. porous (on gravel base)			
8D	4.4-in. porous A.C.	3/15/79	0.0197
2D	2.4-in. porous A.C.	3/15/79	0.0315
7D	1.6-in. porous A.C.	3/15/79	0.0430
Porous vs. porous (on crushed rock base)			
10D	2.9-in. porous A.C.	3/15/79	0.0264
5C	2.1-in. porous A.C.	3/15/79	0.0340
9D	1.2-in. porous A.C.	3/15/79	0.0440

Two problems noted were:

1) the porous pavement flowed or deformed permanently when it was loaded with the pavement surface temperature above 90°F, and

2) turning car tires in place severely scuffed the surface of the porous pavement.

RECOMMENDATIONS

The use of porous pavement under traffic should be limited until further research has been conducted. The porous pavements used in this parking lot and environment appear to be structurally adequate for cars in low volume parking areas constructed on base course and subgrade materials that provide adequate drainage. However, the effects of subgrade, base course, and porous pavement gradations on drainage and on the pavement's structural strength under traffic need further study.

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APPENDIX A: TEST DATA

Table A1. Deflection (in.) - Radius (in.).

Test Pt 1A

LVDT #	1	2	3	4	5
60 PSI*					
11/77	.0144-6.0**	.0080-11.5	.0046-15.25	.0033-17.75	.0010-30.0
4/78	.0167-5.0	.0075-10.75	.0040-14.0	.0025-17.25	.0004-29.75
9/78	.0177-5.75	.0057-12.25	.0037-15.0	.0027-18.5	.0014-30.0
3/79	.0169-5.25	.0102-11.0	.0067-14.88	.0046-17.88	-
80 PSI*					
11/77	.0186-6.0	.0100-11.5	.0062-15.25	.0044-17.75	.0016-30.0
4/78	.0217-5.0	.0098-10.75	.0053-14.0	.0034-17.25	.0006-29.75
9/78	.0221-5.75	.0076-12.25	.0050-15.0	.0037-18.5	.0020-30.0
3/79	.0211-5.25	.0121-11.0	.0087-14.88	.0063-17.88	-
100 PSI*					
11/77	.0230-6.0	.0132-11.5	.0079-15.25	.0057-17.75	.0021-30.0
4/78	.0256-5.0	.0115-10.75	.0064-14.0	.0044-17.25	.0009-29.75
9/78	.0268-5.75	.0091-12.25	.0061-15.0	.0046-18.5	.0026-30.0
3/79	.0239-5.75	.0121-11.0	.0087-14.88	.0063-17.88	-

Test Pt 1B

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0170-5.5	.0075-10.75	.0047-13.5	.0030-17.5	.0010-30.0
4/78	.0158-5.5	.0069-11.25	.0036-14.75	.0022-17.75	.0003-29.75
9/78	.0176-5.75	.0060-12.25	.0035-15.25	.0022-17.75	.0003-29.75
3/79	.0183-5.38	.0094-11.38	.0060-14.89	.0041-18.0	-
80 PSI					
11/77	.0210-5.5	.0110-10.75	.0062-13.5	.0041-17.5	.0013-30.0
4/78	.0187-5.5	.0087-11.25	.0047-14.75	.0030-17.75	.0005-29.75
9/78	.0216-5.75	.0077-12.25	.0058-15.25	.0032-18.75	.0013-30.0
3/79	.0225-5.38	.0114-11.38	.0078-14.88	.0049-18.0	-
100 PSI					
11/77	.0256-5.5	.0138-10.75	.0092-13.5	.0052-17.5	.0016-30.0
4/78	.0217-5.5	.0104-11.25	.0056-14.75	.0036-17.75	.0006-29.75
9/78	.0259-5.75	.0104-12.25	.0056-15.25	.0040-18.75	.0017-30.0
3/79	.0253-5.38	.0133-11.38	.0093-14.88	.0063-18.0	-

* A Load of 60, 80, and 100 psi is approximately equal to 6,800; 9,000; and 11,300 lbs respectively.

** Example: .0144 in. deformation-6.0 in. offset

Test Pt 2A

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0138-5.5	.0070-11.5	.0045-14.5	.0032-17.75	.0010-29.75
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0167-5.5	.0093-11.5	.0061-14.5	.0043-17.75	.0014-29.75
4/78	.0217-5.75	.0074-11.25	.0036-14.5	.0021-17.75	.0003-29.25
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PSI					
11/77	.0195-5.5	.0108-11.5	.0082-14.5	.0054-17.75	.0017-29.75
4/78	.0246-5.75	.0087-11.25	.0045-14.5	.0028-17.75	.0004-29.25
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt 2B

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0153-5.25	.0077-11.0	.0046-14.25	.0031-17.75	.0007-29.0
4/78	.0177-5.5	.0071-10.5	.0032-14.0	.0018-17.75	.0003-28.75
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0190-5.25	.0100-11.0	.0061-14.25	.0040-17.75	.0010-29.0
4/78	.0227-5.5	.0094-10.5	.0045-14.0	.0028-17.75	.0005-28.75
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PSI					
11/77	.0225-5.25	.0120-11.0	.0076-14.25	.0052-17.75	.0015-29.0
4/78	.0256-5.5	.0115-10.5	.0058-14.0	.0032-17.75	.0006-28.75
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt 3A

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0280-5.5	.0070-11.0	.0044-14.75	.0035-17.25	.0015-29.75
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0337-5.38	.0051-11.63	.0033-15.0	.0025-18.25	-
80 PSI					
11/77	.0335-5.5	.0094-11.0	.0059-14.75	.0046-17.25	.0021-29.75
4/78	-	-	-	-	-
9/78	.0359-5.25	.0085-12.0	.0062-14.75	.0049-17.75	.0022-29.5
3/79	.0393-5.38	.0079-11.63	.0049-15.0	.0033-18.25	-
100 PSI					
11/77	.0374-5.5	.0110-11.0	.0068-14.75	.0054-17.25	.0025-29.75
4/78	-	-	-	-	-
9/78	.0413-5.25	.0099-12.0	.0074-14.75	.0060-17.75	.0027-29.5
3/79	.0450-5.38	.0097-11.63	.0060-15.0	.0041-18.25	-

Test Pt 3B

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0280-5.5	.0060-11.0	.0036-15.0	.0028-17.75	.0011-30.0
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0422-5.75	.0076-12.13	.0044-15.5	.0027-18.88	-
80 PSI					
11/77	.0350-5.5	.0080-11.0	.0047-15.0	.0036-17.75	.0013-30.0
4/78	.0335-5.5	.0085-11.5	.0055-15.0	.0042-18.0	.0008-29.75
9/78	.0292-5.25	.0075-12.0	.0052-15.0	.0037-18.0	.0007-29.5
3/79	.0478-5.75	.0089-12.13	.0050-15.5	.0033-18.88	-
100 PSI					
11/77	.0396-5.5	.0100-11.0	.0060-15.0	.0047-17.75	.0020-30.0
4/78	.0374-5.5	.0101-11.5	.0066-15.0	.0044-18.0	.0009-29.75
9/78	.0339-5.25	.0090-12.0	.0063-15.0	.0050-18.0	.0007-29.5
3/79	.0534-5.75	.0102-12.13	.0056-15.5	.0041-18.88	-

Test Pt 4A

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0180-6.75	.0072-12.25	.0043-16.5	.0027-18.5	.0005-30.75
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0217-6.75	.0095-12.25	.0058-16.5	.0040-18.5	.0009-30.75
4/78	.0246-5.5	.0087-11.0	.0046-14.75	.0032-17.75	.0006-28.75
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PS					
11/77	.0256-6.75	.0115-12.25	.0075-16.5	.0050-18.5	.0014-30.75
4/78	.0276-5.5	.0101-11.0	.0055-14.75	.0040-17.75	.0007-28.75
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt 4B

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0157-6.5	.0087-12.0	.0057-15.0	.0038-18.25	.0013-30.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0155-5.38	.0079-11.38	.0053-14.75	.0038-18.13	-
80 PSI					
11/77	.0183-6.5	.0113-12.0	.0075-15.0	.0052-18.25	.0018-30.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0197-5.38	.0108-11.38	.0075-14.75	.0049-18.13	-
100 PSI					
11/77	.0226-6.5	.0136-12.0	.0089-15.0	.0063-18.25	.0023-30.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0253-5.38	.0133-11.38	.0095-14.75	.0066-18.13	-

Test Pt 4C

LVDT #	1	2	3	4	5
60 PS					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0201-5.75	.0065-12.0	.0042-14.75	.0029-18.25	.0014-29.5
3/79	.0191-5.5	.0086-11.63	.0057-15.13	.0038-18.5	.0018-30.25
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0250-5.75	.0082-12.0	.0052-14.75	.0039-18.25	.0018-29.5
3/79	.0225-5.5	.0107-11.63	.0076-15.13	.0049-18.5	.0020-30.25
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0292-5.75	.0101-12.0	.0064-14.75	.0046-18.25	.0022-29.5
3/79	.0267-5.5	.0135-11.63	.0096-15.13	.0066-18.5	.0027-30.25

Test Pt 4D

LVDT #	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0203-5.5	.0055-12.0	.0030-15.25	.0019-18.5	.0004-29.75
3/79	.0169-5.75	.0071-11.88	.0046-15.0	.0027-18.63	.0007-30.63
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0259-5.5	.0071-12.0	.0039-15.25	.0025-18.5	.0006-29.75
3/79	.0211-5.75	.0107-11.88	.0074-15.0	.0049-18.63	.0016-30.63
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0294-5.5	.0088-12.0	.0048-15.25	.0033-18.5	.0009-29.75
3/79	.0264-5.75	.0127-11.88	.0089-15.0	.0063-18.63	-

Test Pt 5A

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0170-5.75	.0095-11.25	.0066-14.75	.0038-18.0	.0010-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0210-5.75	.0115-11.25	.0073-14.75	.0051-18.0	.0014-29.5
4/78	.0236-5.25	.0101-10.75	.0048-14.25	.0032-17.25	.0005-29.25
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PSI					
11/77	.0238-5.75	.0146-11.25	.0088-14.75	.0062-18.0	.0017-29.5
4/78	.0256-5.25	.0115-10.75	.0057-14.25	.0037-17.25	.0007-29.25
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt 5B

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0165-5.75	.0083-11.0	.0046-14.75	.0030-18.0	.0009-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0197-5.5	.0102-11.75	.0067-14.88	.0038-18.38	-
80 PSI					
11/77	.0190-5.75	.0100-11.0	.0058-14.75	.0039-18.0	.0013-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0225-5.5	.0121-11.75	.0083-14.88	.0052-18.38	-
100 PSI					
11/77	.0220-5.75	.0126-11.0	.0074-14.75	.0051-18.0	.0017-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0253-5.5	.0140-11.75	.0094-14.88	.0060-18.38	-

Test Pt 5C

LVDT #	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0223-5.75	.0045-12.25	.0025-15.0	.0017-18.5	-
3/79	.0214-5.63	.0069-11.88	.0042-15.38	.0025-18.38	-
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0268-5.75	.0058-12.25	.0035-15.0	.0023-18.5	-
3/79	.0259-5.63	.0097-11.88	.0058-15.38	.0035-18.38	-
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0294-5.75	.0070-12.25	.0043-15.0	.0029-18.5	-
3/79	.0309-5.63	.0121-11.88	.0075-15.38	.0046-18.38	-

Test Pt 5D

LVDT #	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0219-5.75	.0049-12.5	.0029-15.25	.0021-18.5	.0008-30.0
3/79	.0197-5.38	.0086-11.5	.0053-14.88	.0033-18.38	-
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0263-5.75	.0066-12.5	.0040-15.25	.0031-18.5	.0015-30.0
3/79	.0253-5.38	.0109-11.5	.0071-14.88	.0044-18.38	-
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0312-5.75	.0080-12.5	.0050-15.25	.0035-18.5	.0021-30.0
3/79	.0295-5.38	.0132-11.5	.0087-14.88	.0055-18.38	-

Test Pt 6A

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0150-6.5	.0087-11.75	.0056-15.0	.0037-18.25	.0012-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0174-5.38	.0081-11.25	.0049-15.0	.0035-18.13	.0009-30.13
80 PSI					
11/77	.0186-6.5	.0110-11.75	.0074-15.0	.0050-18.25	.0018-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0225-5.38	.0122-11.25	.0074-15.0	.0055-18.13	.0018-30.13
100 PSI					
11/77	.0220-6.5	.0136-11.75	.0090-15.0	.0066-18.25	.0025-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0267-5.38	.0152-11.25	.0096-15.0	.0068-18.13	.0022-30.13

Test Pt 6B

LVDT #	1	2	3	4	5
60 PSI					
11/77	.0180-4.75	.0100-10.5	.0065-13.75	.0049-16.5	.0011-28.0
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0213-4.75	.0130-10.5	.0087-13.75	.0064-16.5	.0016-28.0
4/78	.0276-5.25	.0092-11.0	.0053-14.25	.0035-17.75	.0007-29.25
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PSI					
11/77	.0254-4.75	.0150-10.5	.0104-13.75	.0078-16.5	.0022-28.0
4/78	.0300-5.25	.0100-11.0	.0066-14.25	.0044-17.75	.0009-29.25
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt. 6C

LVDT #	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0191-5.75	.0061-12.0	.0036-14.75	.0025-18.25	.0011-29.5
3/79	.0174-5.75	.0081-11.63	.0044-15.38	.0033-18.63	.0013-30.5
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0225-5.75	.0084-12.0	.0048-14.75	.0032-18.25	.0014-29.5
3/79	.0225-5.75	.0109-11.63	.0049-15.38	.0044-18.63	.0016-30.5
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0283-5.75	.0203-12.0	.0072-14.75	.0041-18.25	.0019-29.5
3/79	.0267-5.75	.0235-11.63	.0082-15.38	.0055-18.63	.0020-30.5

Test Pt 6D

LVDT#	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0297-5.75	.0073-11.5	.0043-14.5	.0028-17.75	.0012-29.25
3/79	.0297-5.68	.0086-11.88	.0049-15.5	.0033-18.88	.0012-30.5
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0265-5.75	.0096-11.5	.0055-14.5	.0034-17.75	.0015-29.25
3/79	.0242-5.68	.0109-11.88	.0066-15.5	.0044-18.88	.0013-30.5
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0297-5.75	.0110-11.5	.0064-14.5	.0040-17.75	.0018-29.25
3/79	.0295-5.68	.0132-11.88	.0082-15.5	.0055-18.88	.0018-30.5

Test Pt 7A

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0143-4.75	.0073-11.5	.0045-14.75	.0032-17.75	.0011-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0177-4.75	.0097-11.5	.0057-14.75	.0041-17.75	.0015-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PSI					
11/77	.0210-4.75	.0110-11.5	.0068-14.75	.0049-17.75	.0018-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt 7B

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0153-5.5	.0071-11.25	.0040-14.5	.0025-17.5	.0007-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0188-5.5	.0091-11.25	.0053-14.5	.0034-17.5	.0010-29.5
4/78	.0256-5.25	.0076-10.75	.0034-14.5	.0024-17.5	.0005-29.0
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PSI					
11/77	.0210-5.5	.0106-11.25	.0062-14.5	.0040-17.5	.0012-29.5
4/78	.0296-5.25	.0090-10.75	.0041-14.5	.0029-17.5	.0006-29.0
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt 7C

LVDT#	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0212-5.25	.0057-11.75	.0033-14.75	.0026-17.75	.0013-29.75
3/79	.0253-5.5	.0102-11.5	.0060-14.75	.0033-18.0	.0009-29.88
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0262-5.25	.0079-11.75	.0045-14.75	.0037-17.75	.0018-29.75
3/79	.0281-5.5	.0127-11.5	.0076-14.75	.0046-18.0	.0013-29.88
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0310-5.25	.0100-11.5	.0059-14.75	.0046-17.75	.0023-29.75
3/79	.0337-5.5	.0152-11.5	.0093-14.75	.0055-18.0	.0018-29.88

Test Pt 7D

LVDT#	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0197-6.0	.0048-12.0	.0028-15.0	.0015-18.0	-
3/79	.0211-5.38	.0076-11.13	.0038-14.63	.0022-18.13	.0006-29.75
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0252-6.0	.0061-12.0	.0033-15.0	.0022-18.0	-
3/79	.0253-5.38	.0099-11.13	.0052-14.63	.0033-18.13	.0011-29.75
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0290-6.0	.0074-12.0	.0043-15.0	.0028-18.0	.0005-29.75
3/79	.0295-5.38	.0122-11.13	.0066-14.63	.0038-18.13	.0011-29.75

Test Pt 8A

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0133-5.25	.0076-11.0	.0050-14.25	.0037-17.25	.0012-29.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0168-5.25	.0100-11.0	.0066-14.25	.0050-17.25	.0017-29.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PSI					
11/77	.0197-5.25	.0120-11.0	.0081-14.25	.0061-17.25	.0022-29.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt 8B

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0128-5.25	.0069-11.0	.0050-14.5	.0034-17.5	.0015-29.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0160-5.25	.0092-11.0	.0067-14.5	.0053-17.5	.0020-29.25
4/78	.0217-5.0	.0097-10.5	.0053-13.75	.0032-17.0	.0005-28.5
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PSI					
11/77	.0192-5.25	.0110-11.0	.0082-14.5	.0065-17.5	.0025-29.25
4/78	.0246-5.0	.0110-10.5	.0062-13.75	.0040-17.0	.0006-28.5
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt 8C

LVDT#	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0190-5.5	.0067-12.25	.0043-15.25	.0030-18.25	.0012-30.0
3/79	.0197-5.63	.0086-12.0	.0055-15.5	.0038-18.5	.0011-30.13
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0237-5.5	.0086-12.25	.0057-15.25	.0041-18.25	.0017-30.0
3/79	.0225-5.63	.0114-12.0	.0068-15.5	.0049-18.5	.0013-30.13
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0279-5.5	.0105-12.25	.0068-15.25	.0050-18.25	.0023-30.0
3/79	.0281-5.63	.0127-12.0	.0089-15.5	.0063-18.5	.0018-30.13

Test Pt 8D

LVDT#	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0184-5.75	.0073-12.25	.0047-15.0	.0034-18.25	.0012-29.75
3/79	.0197-5.5	.0102-11.5	.0068-15.13	.0049-18.5	.0013-30.25
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0236-5.75	.0096-12.25	.0062-15.0	.0044-18.25	.0018-30.25
3/79	.0225-5.5	.0127-11.5	.0089-15.13	.0060-18.5	.0018-30.25
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0282-5.75	.0116-12.25	.0076-15.0	.0055-18.25	.0020-29.75
3/79	.0253-5.5	.0146-11.5	.0102-15.13	.0075-18.5	.0022-30.25

Test Pt 9A

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0200-5.75	.0100-11.25	.0055-14.75	.0037-17.5	.0010-29.75
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0183-5.5	.0084-11.5	.0050-15.5	.0030-18.63	-
80 PSI					
11/77	.0240-5.75	.0125-11.25	.0071-14.75	.0048-17.5	.0012-29.75
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0225-5.5	.0081-11.5	.0047-15.5	.0027-18.63	-
100 PSI					
11/77	.0270-5.75	.0147-11.25	.0085-14.75	.0057-17.5	.0015-29.75
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0267-5.5	.0133-11.5	.0083-15.5	.0052-18.63	-

Test Pt 9B

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0197-5.0	.0100-10.75	.0060-14.0	.0038-17.25	.0012-29.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0246-5.0	.0136-10.75	.0078-14.0	.0052-17.25	.0016-29.25
4/78	.0256-5.0	.0101-10.5	.0046-14.25	.0031-17.25	.0006-29.0
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PSI					
11/77	.0286-5.0	.0157-10.75	.0095-14.0	.0064-17.25	.0019-29.25
4/78	.0276-5.0	.0115-10.5	.0053-14.25	.0036-17.25	.0007-29.0
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt 9C

LVDT#	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0230-6.0	.0050-12.25	.0033-15.75	.0026-18.5	.0011-30.0
3/79	.0225-5.25	.0081-11.38	.0047-14.88	.0027-18.25	-
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0277-6.0	.0066-12.25	.0044-15.75	.0036-18.5	.0016-30.0
3/79	.0281-5.25	.0114-11.38	.0064-14.88	.0038-18.25	-
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0326-6.0	.0080-12.25	.0053-15.75	.0044-18.5	.0020-30.0
3/79	.0309-5.25	.0140-11.38	.0080-14.88	.0044-18.25	-

Test Pt 9D

LVDT#	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0232-5.5	.0052-11.75	.0036-14.5	.0029-17.75	.0013-30.0
3/79	.0197-5.63	.0083-11.75	.0047-15.0	.0019-18.5	-
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0277-5.5	.0069-11.75	.0047-14.5	.0040-17.75	.0019-30.0
3/79	.0253-5.63	.0108-11.75	.0062-15.0	.0033-18.5	-
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0332-5.5	.0084-11.75	.0059-14.5	.0048-17.75	.0023-30.0
3/79	.0281-5.63	.0127-11.75	.0075-15.0	.0041-18.5	-

Test Pt 10A

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0147-4.75	.0085-11.25	.0055-15.0	.0042-17.75	.0013-29.0
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0169-5.38	.0089-11.38	.0072-14.88	.0044-18.13	-
80 PSI					
11/77	.0180-4.75	.0110-11.25	.0072-15.0	.0054-17.75	.0020-29.0
4/78	.0197-5.5	.0090-11.25	.0051-14.75	.0034-17.75	.0005-30.0
9/78	-	-	-	-	-
3/79	.0197-5.38	.0114-11.38	.0083-14.88	.0057-18.13	-
100 PSI					
11/77	.0204-4.75	.0129-11.25	.0084-15.0	.0066-17.75	.0022-29.0
4/78	.0217-5.5	.0104-11.25	.0057-14.75	.0040-17.75	.0006-30.0
9/78	-	-	-	-	-
3/79	.0225-5.38	.0133-11.38	.0100-14.88	.0071-18.13	-

Test Pt 10B

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0140-6.75	.0078-12.5	.0050-16.0	.0035-19.0	.0012-30.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
80 PSI					
11/77	.0172-6.75	.0100-12.5	.0065-16.0	.0048-19.0	.0017-30.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-
100 PSI					
11/77	.0200-6.75	.0123-12.5	.0080-16.0	.0060-19.0	.0021-30.25
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	-	-	-	-	-

Test Pt 10C

LVDT#	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0183-5.75	.0068-12.25	.0041-15.25	.0025-18.75	.0009-30.25
3/79	.0183-5.5	.0083-11.63	.0053-15.25	.0033-18.38	-
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0223-5.75	.0087-12.25	.0053-15.25	.0033-18.75	.0012-30.25
3/79	.0225-5.5	.0102-11.63	.0069-15.25	.0044-18.38	-
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0252-5.75	.0101-12.25	.0061-15.25	.0039-18.75	.0014-30.25
3/79	.0253-5.5	.0121-11.63	.0082-15.25	.0052-18.38	-

Test Pt 10D

LVDT#	1	2	3	4	5
60 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0169-5.5	.0063-12.0	.0038-15.0	.0017-18.75	-
3/79	.0169-5.38	.0083-11.63	.0053-15.0	.0035-18.25	-
80 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0205-5.5	.0082-12.0	.0051-15.0	.0031-18.75	-
3/79	.0197-5.38	.0102-11.63	.0071-15.0	.0044-18.25	-
100 PSI					
11/77	-	-	-	-	-
4/78	-	-	-	-	-
9/78	.0254-5.5	.0102-12.0	.0065-15.0	.0041-18.75	.0017-30.0
3/79	.0253-5.38	.0127-11.63	.0089-15.0	.0057-18.25	-

Test Pt 11A

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0120-5.25	.0069-10.5	.0049-14.0	.0040-16.75	.0016-29.0
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0129-5.38	.0061-11.38	.0047-15.0	.0031-18.38	-
80 PSI					
11/77	.0148-5.25	.0093-10.5	.0068-14.0	.0055-16.75	.0025-29.0
4/78	-	-	-	-	-
9/78	.0134-5.0	.0085-11.75	.0063-14.75	.0051-18.25	.0023-30.0
3/79	.0157-5.38	.0079-11.38	.0064-15.0	.0049-18.38	-
100 PSI					
11/77	.0180-5.25	.0115-10.5	.0086-14.0	.0070-16.75	.0033-29.0
4/78	-	-	-	-	-
9/78	.0125-5.0	.0084-11.75	.0062-14.75	.0052-18.25	.0025-30.0
3/79	.0180-5.38	.0094-11.38	.0080-15.0	.0060-18.38	-

Test Pt 11B

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0127-5.5	.0080-10.75	.0059-13.5	.0046-17.25	.0025-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0118-5.5	.0076-11.25	.0067-14.88	.0052-18.13	-
80 PSI					
11/77	.0157-5.5	.0107-10.75	.0079-13.5	.0065-17.25	.0035-29.5
4/78	.0202-5.5	.0106-11.5	.0072-14.5	.0055-17.5	.0013-29.25
9/78	.0207-5.25	.0102-11.5	.0072-14.25	.0057-17.75	.0036-29.75
3/79	.0152-5.5	.0102-11.25	.0089-14.88	.0074-18.13	-
100 PSI					
11/77	.0174-5.5	.0124-10.75	.0095-13.5	.0076-17.25	.0043-29.5
4/78	.0241-5.5	.0127-11.5	.0088-14.5	.0066-17.5	.0017-29.25
9/78	.0243-5.25	.0126-11.5	.0092-14.25	.0071-17.5	.0045-29.75
3/79	.0197-5.5	.0140-11.25	.0113-14.88	.0093-18.13	-

Test Pt 12A

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0206-5.5	.0080-11.25	.0046-14.5	.0035-17.5	.0010-29.0
4/78	.0217-5.0	.0069-11.0	.0035-14.0	.0020-17.25	.0004-29.5
9/78	-	-	-	-	-
3/79	.0183-5.38	.0089-11.38	.0055-14.88	.0033-18.5	.0011-30.5
80 PSI					
11/77	.0240-5.5	.0103-11.25	.0062-14.5	.0040-17.5	.0014-29.0
4/78	.0256-5.0	.0086-11.0	.0045-14.0	.0029-17.25	.0006-29.5
9/78	.0198-5.25	.0068-12.75	.0043-15.75	.0030-19.25	.0013-30.5
3/79	.0225-5.38	.0114-11.38	.0068-14.88	.0044-18.5	.0013-30.5
100 PSI					
11/77	.0276-5.5	.0128-11.25	.0070-14.5	.0056-17.5	.0018-29.0
4/78	.0296-5.0	.0104-11.0	.0055-14.0	.0033-17.25	.0007-29.5
9/78	.0223-5.25	.0085-12.75	.0054-15.75	.0040-19.25	.0017-30.25
3/79	.0267-5.38	.0140-11.38	.0087-14.88	.0055-18.5	.0018-30.5

Test Pt 12B

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0145-5.25	.0083-11.25	.0050-14.75	.0034-17.75	.0005-29.25
4/78	.0187-5.75	.0069-11.5	.0034-14.75	.0022-17.75	.0004-29.0
9/78	-	-	-	-	-
3/79	.0208-5.5	.0083-12.25	.0057-15.0	.0035-18.63	.0011-30.38
80 PSI					
11/77	.0180-5.25	.0107-11.25	.0067-14.75	.0045-17.75	.0009-29.25
4/78	.0227-5.75	.0087-11.5	.0045-14.75	.0031-17.75	.0006-29.0
9/78	.0211-5.75	.0084-12.25	.0056-15.0	.0038-18.75	.0015-30.0
3/79	.0239-5.5	.0121-12.25	.0074-15.0	.0049-18.63	.0016-30.38
100 PSI					
11/77	.0220-5.25	.0126-11.25	.0082-14.75	.0057-17.75	.0013-29.25
4/78	.0256-5.75	.0104-11.5	.0054-14.75	.0036-17.75	.0007-29.0
9/78	.0244-5.75	.0101-12.25	.0068-15.0	.0046-18.75	.0019-30.0
3/79	.0281-5.5	.0140-12.25	.0093-15.0	.0063-18.63	.0022-30.38

Test Pt 13A

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0150-5.75	.0074-11.75	.0044-14.75	.0030-18.0	.0008-29.5
4/78	-	-	-	-	-
9/78	-	-	-	-	-
3/79	.0208-5.5	.0083-12.25	.0057-15.0	.0035-18.63	.0011-30.25
80 PSI					
11/77	.0185-5.75	.0096-11.75	.0060-14.75	.0042-18.0	.0012-29.5
4/78	.0222-5.5	.0101-10.75	.0052-14.25	.0035-17.25	.0006-28.25
9/78	.0210-5.75	.0093-12.0	.0058-14.75	.0042-18.25	.0015-29.5
3/79	.0253-5.5	.0140-11.75	.0082-15.13	.0055-18.5	.0009-30.25
100 PSI					
11/77	.0217-5.75	.0117-11.75	.0075-14.75	.0053-18.0	.0015-29.5
4/78	.0246-5.5	.0117-10.75	.0063-14.25	.0042-17.25	.0008-28.25
9/78	.0245-5.75	.0115-12.0	.0075-14.75	.0053-18.25	.0019-29.5
3/79	.0309-5.5	.0165-11.75	.0102-15.13	.0057-18.5	.0016-30.25

Test Pt 13B

LVDT#	1	2	3	4	5
60 PSI					
11/77	.0147-5.25	.0077-11.25	.0046-14.5	.0033-17.75	.0011-29.5
4/78	.0212-5.5	.0067-11.0	.0031-15.0	.0021-17.75	.0004-29.0
9/78	-	-	-	-	-
3/79	.0197-5.5	.0102-11.63	.0063-15.0	.0041-18.5	.0013-30.13
80 PSI					
11/77	.0185-5.25	.0100-11.25	.0060-14.5	.0043-17.75	.0014-29.5
4/78	.0256-5.5	.0085-11.0	.0041-15.0	.0029-17.75	.0005-29.0
9/78	.0244-5.75	.0097-11.75	.0043-14.75	.0043-18.5	.0016-30.0
3/79	.0239-5.5	.0127-11.63	.0076-15.0	.0055-18.5	.0013-30.13
100 PSI					
11/77	.0226-5.25	.0120-11.25	.0074-14.5	.0053-17.75	.0018-29.5
4/78	.0296-5.5	.0104-11.0	.0052-15.0	.0036-17.75	.0008-29.0
9/78	.0256-5.75	.0118-11.75	.0075-14.75	.0053-18.5	.0019-30.0
3/79	.0281-5.5	.0152-11.63	.0096-15.0	.0066-18.5	.0018-30.13

Table A2. Repetitive plate bearing test results at Walden Pond in order of strength.

November 1977	April 1978	September 1978	March 1979
11A - .0148**	2B - .0187	11A - .0134	11B - .0152
11B - .0157	10A - .0197	12A - .0198	11A - .0157
8B - .0160	11B - .0202	10D - .0205	10A - .0197
2A - .0167	1A - .0217	11B - .0207	10D - .0197
8A - .0168	2A - .0217	13A - .0210	4B - .0197
10B - .0172	8B - .0217	12B - .0211	1A - .0211
7A - .0177	13A - .0222	1B - .0216	4D - .0211
12B - .0180	2B - .0227	1A - .0221	1B - .0225
10A - .0180	12B - .0227	10C - .0223	4C - .0225
4B - .0183	5A - .0236	6C - .0225	5B - .0225
13B - .0185	4A - .0246	8D - .0236	5D - .0225
13A - .0185	7B - .0256	8C - .0237	6C - .0225
1A - .0186	9B - .0256	13B - .0244	8C - .0225
6A - .0186	12A - .0256	4C - .0250	8D - .0225
7B - .0188	13B - .0256	4D - .0259	9A - .0225
2B - .0190	6B - .0276	7C - .0262	10C - .0225
5B - .0190	3B - .0335	5D - .0263	12A - .0225
1B - .0210		6D - .0265	12B - .0239
5A - .0210		5C - .0268	13B - .0239
6B - .0213		9C - .0277	6D - .0242
4A - .0217		9D - .0277	5D - .0253
9A - .0240		3B - .0292	7D - .0253
12A - .0240		3A - .0359	9D - .0253
9B - .0246			13A - .0253
3A - .0335			5C - .0259
3B - .0350			7B - .0281
			9C - .0281
			3A - .0393
			3B - .0478

* Deflections taken at the plate under a 80 PSI load.

** Point - Deflection in inches.

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